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THE SUCCESS OF THE ELECTRIC LIGHT.

Not a little impatience has been manifested by the public at the seemingly unaccountable tardiness with which the work of introducing the "carbon-loop" electric lamp into general use has hitherto progressed. It is now several months since the announcement was made through the newspapers that all the obstacles in the way of the utilization of the electric light as a convenient and economical substitute for gaslight had been removed: that a method had been invented by which electricity for light or for power could be conveyed to considerable distances economically; that the current could be subdivided almost *ad infinitum;* and that the electric lamp was henceforth to be as manageable for household purposes as a gas-jet. But, so far as the public can see, the project has since that time made no appreciable advance toward realization. The newspapers have reported, on the whole with a very fair degree of accuracy, the results of the experiments made with this system of lighting at Menlo Park; scientific experts have published their judgments, some of them pronouncing this system to be the desiderated practical solution of, the problem of electrical lighting which has vexed the minds of physicists since the day when Sir Humphry Davy produced his famous five-inch voltaic arc. Still it must be confessed that hitherto the "weight of scientific opinion" has inclined decidedly toward declaring the system a failure, an impracticability, and based on fallacies. It will not be deemed discourteous if we remind these critics that scientific men of equal eminence pronounced ocean steam-navigation, submarine telegraphy, and duplex telegraphy, impossibilities down to the day when they were demonstrated to be facts. Under the circumstances, it was very natural that the unscientific public should begin to ask whether they had not been imposed upon by the inventor himself, or hoaxed by unscrupulous newspaper reporters.

Now, the fact is, that this system of electrical lighting was from the first all that it was originally claimed to be, namely, a practical solution of the problem of adapting the electric light to domestic uses and of making it an economical substitute for gaslight. The delays which have occurred to defer its general introduction are chargeable, not to any defects since discovered in the original theory of the system or in its practical working, but to the enormous mass of details which have to be mastered before the system can go into operation on a large scale, and on a commercial basis as a rival of the existing system of lighting by gas.

With the lamp and generator which at the time of the first announcement it was proposed to use, the electric light could have been made available for all illuminating purposes as gas is now; the expense would have been considerably less with the electric light; the lamp would have been quite as manageable as a gas-burner. But, fortunately, the unavoidable delay interposed by administrative and economic considerations afforded opportunity for further research and experiment, and the result has been to introduce many essential modifications at both ends of the system—both in the generator and in the lamp; at the same time sundry important changes, all in the direction of economy and simplification, have been made at almost every point in the system, as well as in the details of manufacturing the apparatus.

As for the lamp, it has been completely transformed. The external form of the two types of lamp is identical; the principle of illumination—incandescence of a solid body *in vacuo*—is also the same; but, in the earlier lamp, light was produced by the incandescence of a platinum wire wound on a spool of zircon; in the perfected lamp the source of light is incandescent carbon. Another essential difference between the two is found in the form given to the incandescent body: in the platinum lamp it was coiled compactly on a small spool; in the carbon lamp it is a loop some five inches in total length. This incandescent loop is found in practice to afford a better light for domestic purposes than an incandescent mass of compact form: the shadows it casts are not so sharply defined, their edges being softened.

This loop of carbon is now prepared from the fiber of a cultivated species of bamboo from Japan. A thread of this material, after undergoing a certain chemical process, is bent into the required shape, and then reduced to carbon. The resulting carbon loop is of a remarkably homogeneous structure, and possessed of a high degree of tenacity, so that it can withstand, without breaking, all the concussions it is likely to be subjected to in household use.

The perfected lamp consists of an oval bulb of glass about five inches in height, pointed at one end, and with a short stem three quarters of an inch in diameter at the other. Two wires of platinum enter the bulb through this stem, supporting the loop or ∩-shaped thread of carbon, which is about two inches in height. The stem is hermetically sealed after the introduction of the carbon loop. At its pointed end the bulb terminates in an open tube through which the air in the bulb is exhausted by means of a mercury-pump till not over one millionth part remains; the tube is then closed. The outer extremities of the two platinum wires are connected with the wires of an electric circuit, and at the base of the lamp is a screw by which the circuit is made or broken at pleasure. When the circuit is made, the resistance offered to the passage of the electric current by the carbon causes the loop to acquire a high temperature and to become incandescent; but, as this takes place in a vacuum, the carbon is not consumed. The "life" of a carbon loop through which a current is passed continuously varies from seven hundred and fifty to nine hundred hours. With an intermitted current, the loop has an equal duration of life; and, as the average time an artificial light is used is five hours per day, it follows that one lamp will last about six months. Each lamp costs about fifty cents, and when one fails another may easily be substituted for it.

The light is designed to serve precisely the same purposes in domestic use as gaslights. It requires no shade, no screen of ground glass, to modify its intensity, but can be gazed at without dazzling the eyes. The amount of light is equal to that given by the gas-jets in common use; but the light is steadier, and consequently less trying to the eyes. It is also a purer light than gas, being white, while gaslight is yellow. Further, the electric lamp does not vitiate the surrounding atmosphere by consuming its oxygen, as gaslights do, and discharging into it the products of combustion. The heat emitted by the lamp is found to be only one fifteenth of that emitted by a gaslight of equal illuminating power: the glass bulb remains cool enough to be handled. Of course, there are here no poisonous or inflammable gases to escape, and the danger of fire is reduced to *nil*, with a consequent reduction of the rate of insurance. Again, this light, unlike gas, is always of uniform quality. A sort of meter registers exactly the amount of electricity consumed in each house. Finally, not to enumerate all the advantages which this system possesses over gas-lighting, the lamp can be manipulated even by the most inexperienced domestic servant; nor can the most careless person do injury to himself, to others, or to property, through not understanding its mechanism.

Another important modification of the system, introduced since the latest authorized account of the light was published, is the substitution of dynamo-machines for magneto-machines in the stations from which the electricity is to be supplied to the several districts of a city. Here, again, the change is entirely in the direction of simplicity and economy. Where before it was proposed to furnish a station with one hundred magneto-machines with a multiplicity of belts and shafting, we now make ten dynamos of 120-horse power, each worked directly by a 120-horse-power engine. We thus do away with a very considerable loss of power, and at the same time the outlay for machinery is very much lessened.

With these and other modifications of the system, which need not be particularized here, it may be safely affirmed that the limit of economy, simplicity, and practicability has been reached. The time for experiment has passed; any further improvements to be made in the system must be suggested by its performance when put to the test of actual use on a large scale.

To the question which is so often asked, When will a public demonstration of the working of this system be made? we would reply that such a demonstration will in all probability be made at Menlo Park within two months from this date. The time which has elapsed since the preliminary demonstration of last January has been by no means a season of inaction for the promoters of this enterprise. There is a vast gulf between the most successful laboratory experiment possible and the actualization of the results of that experiment in a commercial sense. A prodigious amount of work was necessitated by the establishment of factories for producing the lamps, the generators, and the other essential parts of the system in large quantities, so as to be able to supply the first demand. We were about to enter a field that was practically unexplored, and, even on a preliminary survey, problems of the most complex kind arose on every side. These had to be solved before the first step could be taken toward the actual introduction of the light into our cities as a substitute for gas. The practical engineer and the man of business can best appreciate the difficulties that had to be overcome. Like difficulties have in the past retarded the general introduction of nearly all the great mechanical and chemical inventions. Years intervened between the discovery of photography and the taking of the first photograph; the steam-engine, the steamboat, the locomotive-engine, did not come till long years after the discovery of their scientific principles; the same is true of the telegraph.

But preparations are being actively made for placing this system of electric lighting within reach of the people in all the great centers of population throughout the United States. To this end, cities are being mapped and divided into districts, each to be supplied with electricity from a central station; estimates are being made of the exact cost of plant in the different cities; contracts are being negotiated for the manufacture on a large scale of engines, dynamos, lamps, wire, and all the other supplies needed for the practical introduction of the system throughout the country; men are being trained to put up the plant of central stations, to run the machines, and to execute all the details of the introduction and working of the system.

A very important question is that of the cost of this light. The price of the electric light will, of course, be determined by the capitalists who invest their money in it as a business venture, but it will of necessity be low as compared with gaslight, though it will vary according to the original cost of plant, the demand in any given locality, and other conditions. It is not at present the intention of the company controlling the patents on this system to supply the light directly to consumers. The company will erect the first station in New York City, and will themselves conduct that station; but the other stations in New York, as well as in the other cities throughout the United States, will be managed by local companies, who will pay a royalty to the Electric Light Company for the right to use the system.

So much can be safely affirmed, that this light can be sold at a price which will make competition on the part of the gaslight companies impossible: 1. Because the total investment in plant to develop a given quantity of light is much less; 2. Because the depreciation of plant is much less; 3. Because the cost for labor employed is very much less than in gas-works; 4. Because the electric-light companies will not have to make any dead investment in large areas of real estate; it is not even necessary to erect buildings specially to serve as stations, for the ordinary buildings, such as are used for different branches of manufacture, will serve the purpose, and may be hired on rental; 5. Because the companies can sell electricity for two uses—for light at night, and for power in the daytime. It has been ascertained by experiment that power can be supplied through this system from twenty-five-horse power down to $\frac{1}{100}$ of a horse-power on the same mains that supply the light, and that elevators, printing-presses, sewing-machines, fans, pumps, etc., can be run by electricity from a central station far more economically than by any other means. A canvass of the city of New York has shown that the demand for small powers, in private dwellings and minor industrial establishments, will give occupation to the central stations in the lower part of the city for ten hours daily. This power can be supplied at such a profit to the companies as to more than cover the expense of running the stations for six hours longer in producing electric light. It is evident, therefore, that, in a competition with gas, the electric light possesses an enormous advantage.

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